Distributed Management and Orchestration of 5G networks with AI based mechanisms

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5G Network and beyond

5G technology is expected to be a crucial factor in different sectors
Health care
Industry
Entertainment
Agriculture and Farming
Smart cities

Heterogeneous services are allowed to coexist within the same network architecture by means of *Network Slicing*

Network Slicing uses virtually partitions of a physical network into several logical networks in order to provide the most suitable resources and network topology to different types of services

Massive numbers of coexisting network slices with different
Performance requirements
Functionality
Timespans

MONB5G project

Provides scalability both for the management and orchestration system and the resources of the slices it hosts

Propose **zero-touch** slicing design that includes

- ✓**autonomic**
- ✓**cognitive (data- and AI-driven)**
- ✓**closed-loop management and orchestration**

for network slices beyond traditional MANO

Verify and provide scalable, decentralized, and secure network slice management and orchestration *for beyond 5G* Networks

Develop KPIs related to network slice management and orchestration

Network automation

Automating network management and operations is vital for network modernization and the digital transformation

What is Network automation ?

Elimination of repeatable manual tasks and their replacement by programmed tasks automated with the use of software

Examples of automated tasks include

Monitoring

Troubleshooting

Configuration of network

Optimization of network

Scheduling maintenance

Adding or disconnecting services

Network orchestration

Orchestration is referring to the management of automated workflows across the network

Includes the automated arrangement and coordination of complex networking systems, resources and services from multiple administrative domains

New technologies

- SDN/NFV
- Artificial intelligence
- 5G
- IoT

MonB5G allows

- Flexible and efficient management of network tasks
- Introduces a diverse set of centralization levels through

✓ Optimal adaptive assignment of monitoring analysis

✓ Decision-making tasks

MONB5G project

MonB5G will build on top of the **3GPP** network slicing management framework

- Provides scalability for the management and orchestration system and the resources of the slices
- Uses dynamic utilization of resources in every technological domain implementing a suitable lifecycle management of a sub-slice

MonB5G uses standards-based

MANO and MEC frameworks

Extending these frameworks with embedded cognitive capabilities

Provides trust mechanisms adapted to the targeted multi-stakeholder environment for secure and trustworthy cross-domain operations

MONB5G project

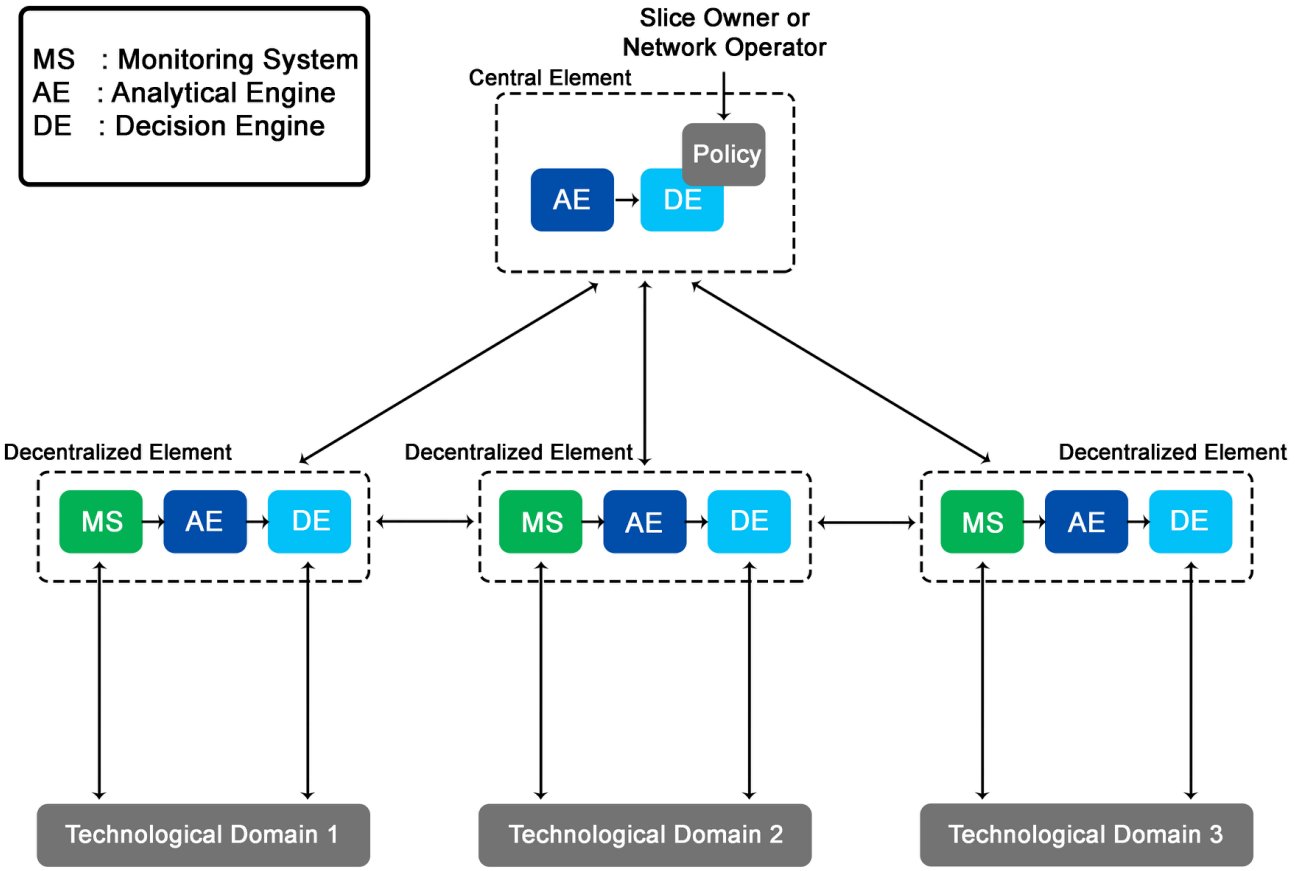
MonB5G will implement network slice reconfiguration with the aid of Artificial Intelligence

The project will evolve the traditional centralized

Cloud management system architecture with

- Monitoring System (MS)
- Analytics Engine (AE)
- Decision Engine (DE)

MONB5G Architecture



Use Cases / Scenarios

UC1 Zero-Touch Network and service management with end-to-end SLAs

- **Sen1 Zero-Touch multi-domain service management with end-to-end SLAs**
- **Sen2 Elastic end-to-end slice management**

UC2 AI-assisted policy-driven security monitoring & enforcement

- **Sen1 Attack identification and mitigation**
- **Sen2 Robustness of learning algorithms in the face of attacks**

UC1/Sen1 Zero-Touch multi-domain service management with end-to-end SLAs

This use case will be implemented and evaluated at CTTC's testbed

MonB5G uses distributed mechanisms (MS, DE, AE) to provide automated, zero-touch service management across domains

This scenario will aim to assess the data-driven management systems in a multi-domain scenario with regard to their ability to guarantee the stringent end-to-end SLA of the Tactile Internet (Augmented Reality application for virtual event attendance)

Demonstration of Zero-Touch service management in complex multi-domain services to address faults and performance issues in any of the service and technological domains

- ✓ Self-healing
- ✓ Self-configuring
- ✓ Self-scaling of services

UC1/Sen2
Elastic end-to-end slice management

MonB5G mechanisms react to address

Local performance issues in multiple technological domains 5G Core, RAN and Transport network

Changes to traffic patterns in various timescales

PoC

- Continuous monitoring of each NSSI by the respective Monitoring Engine at appropriate time-scales to identify performance issues

- Decision Engines at each domain are able to
  - Recover local faults
  - Forward model updates sub-slice performance to the central Decision Engine

- Sub-slice performance data will be combined with traffic pattern predictions at the Decision Engine, and proactive actions will be taken to prevent missing end-to-end service SLAs

- Proactive Actions are implemented by the respective domain controller

Barcelona's PoC Platform
CTTC

5G testbed, located at CTTC premises is based on

5G core

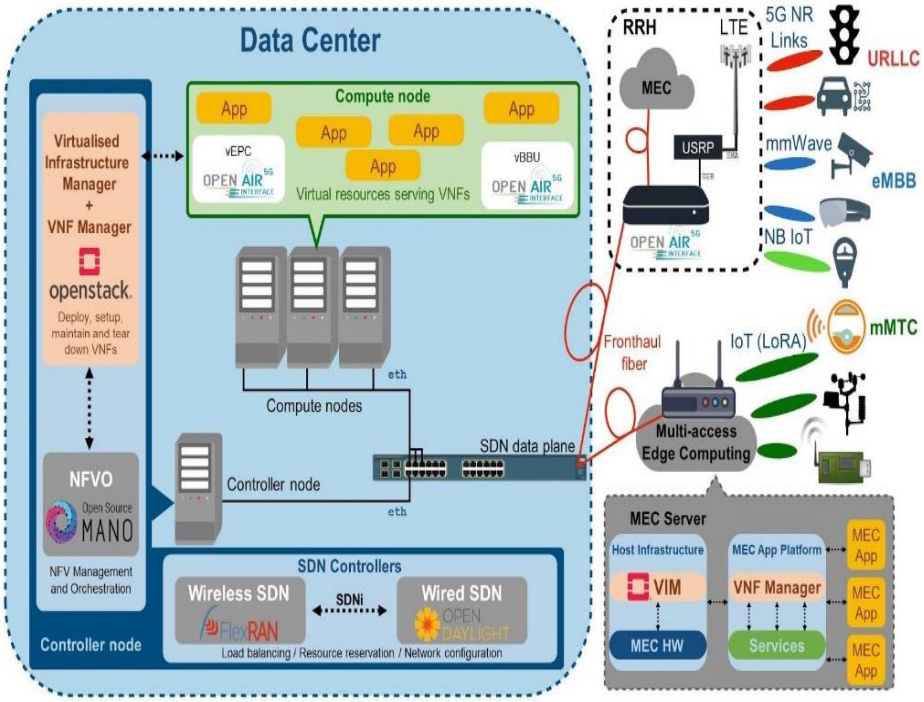
Fully virtualized 5G RAN

Cloud Radio Access Network

(C-RAN) architecture

Optical/wireless Fronthaul

The platform can be configured to emulate multi-domain infrastructures



UC2 AI-assisted policy-driven security monitoring & enforcement

Scenario 1: Attack identification and mitigation

This scenario will aim to demonstrate the robustness of MonB5G for identifying, detecting and then mitigating the in-slice and cross-slice attacks

MonB5G efficiency when relying on AI to ensure legacy/new security threats detection

Proper enforcement of the AI-based techniques through novel trust-based evaluation mechanisms

Scenario 2: Robustness of learning algorithms in the face of attacks

This scenario will aim to demonstrate that even under significant numbers/ratios of misbehaving entities, distributed learning can be carried out in a robust way

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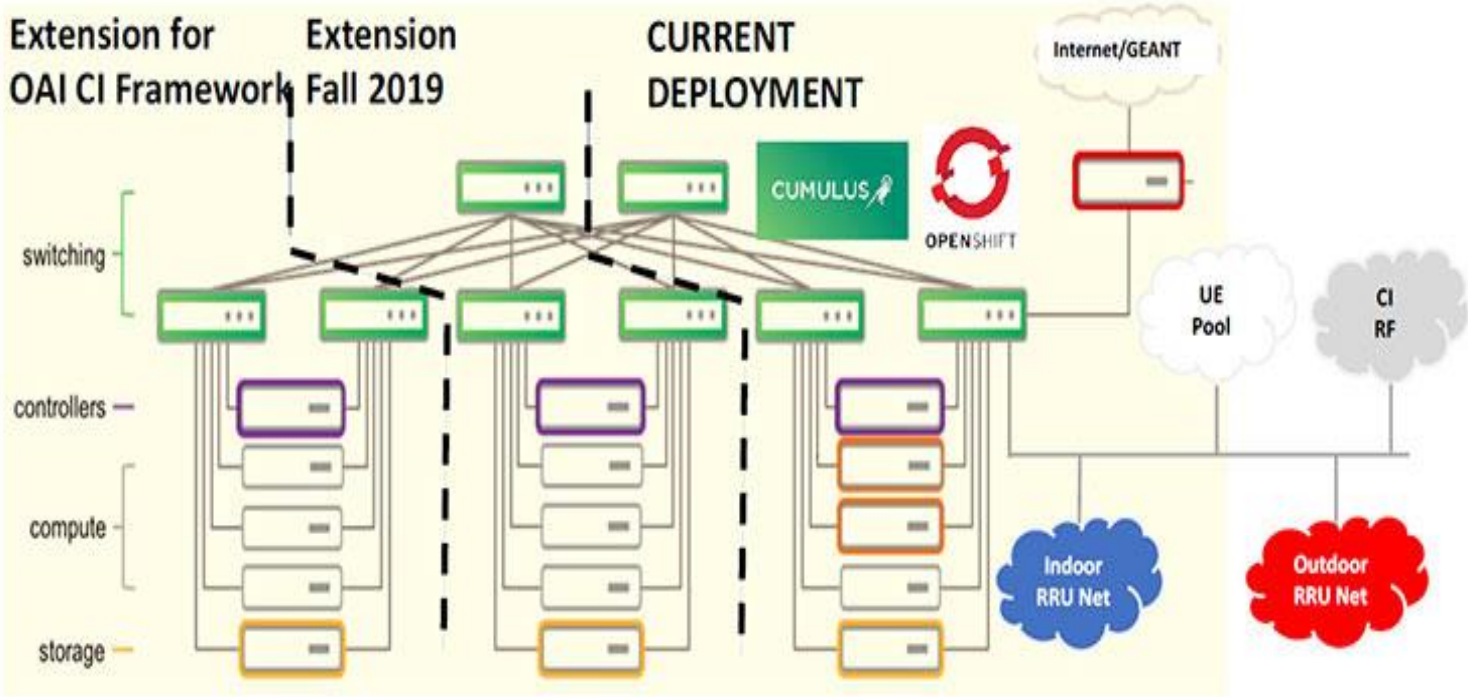
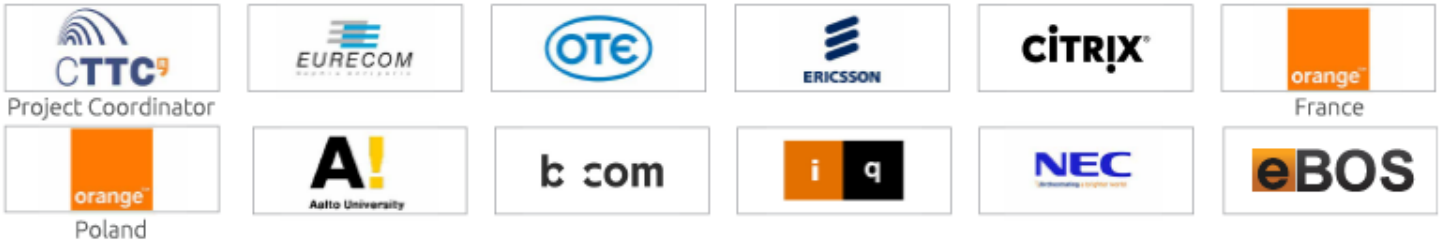


MonB5G Stakeholders

- Infrastructure provider
- Infrastructure broker
- Network slice provider
- Network slice management provider
- Slice template provider
- Slice operator
- VNF provider
- Slice tenant
- Service broker
- Service/content provider
- End-user

MonB5G Participants

CONSORTIUM



https://www.monb5g.eu

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